Occupational Safety Competency 1.6

Competency 1.6 **Occupational safety personnel shall demonstrate a working level knowledge of ergonomic hazards and the elimination or control of them.**

1. Supporting Knowledge and Skills

a. Discuss the basic terminology associated with ergonomics.

b. Describe ergonomic considerations that must be addressed when evaluating new or existing jobs, processes, or operations, and identify appropriate methods for the elimination or control of ergonomic hazards.

c. Explain the application of “signal risk factors” with regard to ergonomic hazards.

d. Discuss the methodology for analyzing lifting tasks.

e. Discuss the significance of repetitive motions and tasks.

f. Discuss the importance of worker interfaces with operational equipment.

2. Self-Study Activities (corresponding to the intent of the above competency)

Below are two web sites containing many of the references you may need.

Web Sites		
Organization	**Site Location**	**Notes**
Department of Energy	http://wastenot.inel.gov/cted/stdguido.html	DOE Standards, Guides, and Orders
OSHA	http://www.osha-slc.gov/	OSHA documents and search engine
U.S. House of Representatives	http://law.house.gov/cfr.htm	Searchable Code of Federal Regulations

Read the summary to this study guide and the National Safety Council *Fundamentals of Industrial* Hygiene, 4th edition, pages 7-24 and 29-31.

NOTE: Both the Department of Energy (DOE) and the Occupational Safety and Health Administration (OSHA) have draft ergonomics standards available for review. Neither are final, approved, or complete, but they do provide a look at the direction the Federal government is taking in ergonomics policy. The DOE version is available through DOE Office of Environment, Safety, and Health Technical Information Services at: gopher://nattie.eh.doe.gov:2011/11/.standards or by calling 301-903-9765. The OSHA version may be downloaded from the following World Wide Web site: http://www.osha-slc.gov/misc/ergo_draft.html

EXERCISE 1.6-A Define the following terms as they relate to ergonomics.
NOTE: Since ergonomics borrows from several disciplines, this is a representative sampling of common terms. Refer to the glossary (Appendix A) for a more extensive listing of occupational safety terms.

- Administrative controls
- Awkward posture
- Control the job or controlled job
- Engineering controls
- Equipment
- Ergonomics
- Fixed posture
- Incidence rate
- Job
- Lower extremity
- Package
- Personal protective equipment
- Restrictions
- Severity rate
- Tasks
- Unassisted frequent or forceful manual handling
- Upper extremity
- Vibration
- Work methods
- Workplace
- Workplace risk factors
- Work-related musculoskeletal disorder

EXERCISE 1.6-B Describe ergonomic considerations that must be addressed when evaluating new or existing jobs, processes, or operations, and identify appropriate methods for the elimination or control of ergonomic hazards.

EXERCISE 1.6-C Identify and explain the application of the five “signal risk factors” with regard to ergonomic hazards.

EXERCISE 1.6-D Where can data requirements and procedures for using the National Institute for Occupational Safety and Health's (NIOSH's) revised lifting equation be found?

EXERCISE 1.6-E Discuss the significance of repetitive motions and tasks.

EXERCISE 1.6-F Referring to *Fundamentals of Industrial Hygiene*, Chapter 13, "Ergonomics," discuss workplace design and identify the six general principles to follow in the preparation of a design for a specific workplace.

3. Summary

Work systems (see Figure 1.6-1) require a balance between technology (tools and equipment), the organization, the environment, the job, and the individual (Smith and Sainfort 1988). When any one of the basic connections between these elements is not functioning optimally, the work system is impaired.

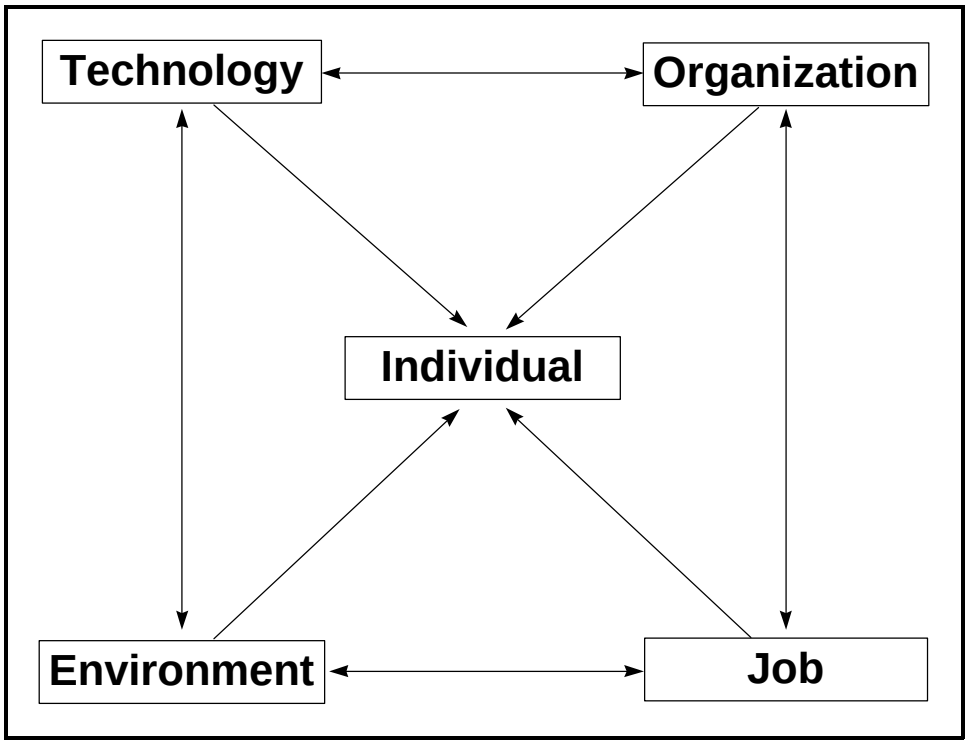

Figure 1.6-1 Work Systems

Changes in attributes such as productivity and quality can reveal work system impairment. Productivity can be influenced by malfunctioning tools and equipment, employee turnover, and problems that may arise due to the physical demands employees face in performing their jobs. Likewise, malfunctioning tools and equipment, insufficient training, lack of feedback, and unrealistic production requirements can affect quality. The occurrence of work-related musculoskeletal disorders can also indicate work system imbalance. As reflected in Figure 1.6-1, an individual may be affected by technology (e.g., semiautomation that increases repetitive motions), environmental factors (e.g., poor lighting that leads to awkward postures or heat that contributes to fatigue), or physical demands that exceed the individual's capabilities. If signs of system imbalance are present, employers must take steps to identify the causes and implement the controls needed to bring the system back into balance.

An imbalance can result in a “problem job,” which can lead to musculoskeletal disorder. Ergonomic principles can be used to prevent or resolve problem jobs that result from a mismatch between the worker and the work system.

Ergonomics involves performance of the following tasks:

- Recognizing where the opportunities exist to reduce or eliminate risk factors associated with musculoskeletal disorders (i.e., new and existing jobs or processes)
- Using the problem-solving process to identify causes of system imbalance (e.g., risk factors associated with musculoskeletal disorders)
- Performing a more detailed job analysis to identify the root cause of ergonomic problems in complex tasks
- Analyzing manual handling tasks, such as lifting, lowering, pushing, pulling, twisting (torquing) and carrying
- Identifying controls, the different classifications of controls, and the different opportunities for controls for new and existing jobs and processes
- Identifying procedures for evaluating, selecting, implementing, and measuring controls

NOTE: *Specific information or analysis should be obtained through an expert in ergonomics.*

4. Exercise Solutions

EXERCISE 1.6-A Define the following terms as they apply to ergonomics.
NOTE: Since ergonomics borrows from several disciplines, this is a representative sampling of common terms.

ANSWER 1.6-A

Terms Related to Ergonomics	
Term	**Definition**
Administrative controls	Any procedures that significantly limit daily exposure by control or modification of the work schedule or manner in which work is performed. Administrative controls include, but are not limited to, job rotation, use of rest breaks or alternative tasks, job enlargement to increase task variability, redesign of work methods, and adjustment of work pace to reduce the number of repetitions.
Awkward posture	A deviation from the neutral position of any particular joint. Examples include, but are not limited to, twisting, bending, kneeling, squatting, and stooping.
Control the job or controlled job	To implement control measures that reduce or prevent employee exposure to workplace risk factors.
Engineering controls	Physical changes to workstations, equipment, materials, production facilities, or any other relevant aspect of the work environment that reduce or prevent exposure to workplace risk factors.
Equipment	Tools, machines, vehicles, devices, furniture, installations, and other components in the work system.
Ergonomics	The field of study that seeks to fit the job to the person, rather than the person to the job. This is achieved by the evaluation and design of workplaces, environments, jobs, tasks, equipment, and processes in relationship to human capabilities and interactions in the workplace.
Fixed posture	Prolonged muscle contraction without movement, such as maintaining an unsupported posture or prolonged gripping of a tool.
Incidence rate	The number of new work-related musculoskeletal disorders that occur during a year per 100 full-time equivalent workers. Incidence rates are calculated as follows: (number of new work-related musculoskeletal disorders) x (200,000 work hours or 100 full-time equivalent workers)/(work hours per year or total number of full-time equivalent workers)

Terms Related to Ergonomics	
Term	**Definition**
Job	The performance of a series of tasks in order to reach a goal or defined end product, including a job assignment to complete specific tasks.
Lower extremity	The hip, thigh, knee, leg, ankle, and/or foot.
Package	Material(s) or object in a container where the contents are not known and the weight cannot be ascertained by the handling employee, e.g., a cardboard box containing cans of paint or a suitcase in baggage handling.
Personal protective equipment	Devices such as, but not limited to, corrective lenses for work with video display units, gloves, or padding, worn on or attached to the body, which are used for the purpose of controlling workplace risk factors.
Restrictions	Any limitation placed on the manner in which an employee performs a job or work tasks during the recovery period. Restrictions refer collectively to any of the following: alternative duty assignment, alternative work, light duty, job modifications, job restrictions, and modified duty.
Severity rate	The number of lost work days due to work-related musculoskeletal disorders occurring in a year per 100 full-time equivalent workers. Severity rates are calculated as follows: (number of lost workdays) x (200,000 hours or 100 full-time equivalent workers)/(work hours per year or number of full-time equivalent workers).
Task	A subunit of a job or the group of activities that must be performed to accomplish the work objective or the job.
Unassisted frequent or forceful manual handling	Lifting, lowering, carrying, handling or pushing/pulling animals, people, heavy objects, equipment, or tools without assistance from mechanical devices.
Upper extremity	The hand, wrist, elbow, arm, shoulder and/or neck.

Terms Related to Ergonomics	
Term	**Definition**
Vibration	The oscillatory motion of a physical body. Localized (segmental) vibration, such as hand-arm vibration, is produced by contact with powered tools or equipment, or vibrating structures. Whole-body vibration exposure occurs while standing or seated in vibrating environments or objects, such as trucks or heavy machinery, or while using heavy equipment, such as jackhammers.
Work methods	The physical methods used to perform the tasks of a job, such as reaching, gripping, using tools and equipment, or discarding objects.
Workplace	An establishment, job site, or project, at one geographical location.
Workplace risk factors	Actions in the workplace, workplace conditions, or a combination thereof, that may cause or aggravate a work-related musculoskeletal disorder. Workplace risk factors include, but are not limited to, repetitive, forceful, or prolonged exertions; frequent or heavy lifting; pushing, pulling, or carrying of heavy objects; a fixed or awkward work posture; contact stress; localized or whole-body vibration, cold temperatures; and poor lighting (leading to awkward postures). These workplace risk factors can be intensified by work organization characteristics, such as inadequate work-rest cycles, excessive work pace and/or duration, unaccustomed work, lack of task variability, machine-paced work, and piece rate.
Work-related musculoskeletal disorder	An injury or illness of the muscles, tendons, ligaments, peripheral nerves, joints, cartilage (including intervertebral discs), bones, and/or supporting blood vessels in either the upper or lower extremities, or back, which is associated with musculoskeletal disorder workplace risk factors and which is not the result of acute or instantaneous events (e.g., slips or falls). Classifications such as, but not limited to, cumulative trauma disorders, repetitive strain injuries or illnesses, repetitive motion injuries or illnesses, and repetitive stress injuries or illnesses are included in this definition.

EXERCISE 1.6-B Describe ergonomic considerations that must be addressed when evaluating new or existing jobs, processes, or operations, and identify appropriate methods for the elimination or control of ergonomic hazards.

ANSWER 1.6-B Designers, suppliers, and manufacturers who provide assistance in identifying and applying ergonomic design principles should be consulted when evaluating new jobs in order to prevent new problems from being created. The use of workplace risk factor checklists should assist the occupational safety professional in assessing existing jobs or changes in existing jobs. Appropriate methods for elimination or control of ergonomic hazards will depend on the specific situation. Refer to an ergonomics specialist for assistance.

EXERCISE 1.6-C Identify and describe the application of the five “signal risk factors” with regard to ergonomic hazards.

ANSWER 1.6-C The five “signal risk factors” are as follows;
NOTE: The information below is found in the OSHA draft ergonomics standard.

Five Signal Risk Factors	
Signal Risk Factor	**Description**
Performance of the same motion or motion pattern every few seconds	Frequent repetitions of the same motions stress the body parts involved. The repetition may be of a "pattern" where several motions get repeated every few seconds, e.g., completion of the task may involve three steps that get repeated in sequence every few seconds. Much assembly line work involves repetition for long periods of time. When this repetition occurs for more than two hours at a time during the work shift without a break, the body may not have time to sufficiently rest the body parts that are being repeatedly stressed.

Five Signal Risk Factors	
Signal Risk Factor	**Description**
A fixed or awkward work posture (for example, overhead work, twisted or bent back, bent wrist, kneeling, stooping, or squatting)	Holding body parts in fixed or awkward postures for more than two hours during a work shift also creates excess stress that can cause or aggravate work-related musculoskeletal disorders.
Use of vibrating or impact tools or equipment	Stress on the body due to vibration or impact of tools or equipment has also been shown to cause work-related musculoskeletal disorders. These may be hand-held power tools, such as a power sander, or large pieces of equipment that are being driven, such as forklifts.
Forceful hand exertions	-- No description available --
Unassisted frequent or forceful manual lifting	Many jobs require workers to lift, carry, or otherwise handle objects. Generally speaking, the heavier the object is, the greater risk to the employees handling it. However, frequency of lifting or handling is also a concern, as are the size and shape of the objects, the distance they have to be carried, and the height from which or to which they have to be lifted.

EXERCISE 1.6-D Where can data requirements and procedures for using NIOSH's revised lifting equation be found?

ANSWER 1.6-D NIOSH developed *Applications Manual for the Revised NIOSH Lifting Equation* (DHHS [NIOSH] Pub. No. 94110). The applications manual contains new procedures for assessing multitask lifting jobs and a series of example problems to demonstrate use of the revised lifting equation.

EXERCISE 1.6-E Discuss the significance of repetitive motions and tasks.

ANSWER 1.6-E *Repetition* refers to a task or series of motions that is performed over and over again, with little variation. If tasks or motions are repeated frequently (e.g., every few seconds), fatigue and muscle-tendon strain can accumulate, which can result in permanent tissue damage. Tendons and muscles can often recover from the effects of stretching or forceful exertions if sufficient time is allotted between exertions. Frequent repetition of the same work activities can also exacerbate the effects of awkward postures and forceful exertions.

EXERCISE 1.6-F Referring to the National Safety Council's *Fundamentals of Industrial Hygiene*, Chapter 13, "Ergonomics," discuss workplace design and identify the six general principles to follow in the preparation of a design for a specific workplace.

ANSWER 1.6-F The objective in designing a workstation is to provide an environment free of unnecessary stresses. Productivity will suffer if the operator is uncomfortable or if controls are awkwardly placed. Because of the many factors affecting the interaction between operators and the equipment they control, it may not be possible to provide an optimum environment in all respects. However, careful consideration of the capacities and limitations of the user population and of the system performance requirements will lead to the best possible compromises.

Six general rules to follow in the preparation of a design for a specific workplace are as follows:

1. Plan the whole, then the detail.
2. Plan the ideal, then the practical.
3. Plan the process and equipment around the system requirements.
4. Plan the layout around the process and equipment.
5. Plan the final enclosure around the layout.
6. Use mock-ups to evaluate alternative layouts and to check the final layout.